CLAIMS

1. An encoding device characterized by comprising:

wavelet transforming means for dividing a two-dimensional signal into subbands as a plurality of frequency regions;

coefficient extracting means for extracting sets of coefficients for every predetermined number of sets of coefficients which belong to the same spatial position from a plurality of subbands which belong to a wavelet decomposition level of the same hierarchy; and

coefficient encoding means for encoding the extracted coefficient sets.

2. An encoding device according to claim 1, characterized in that said coefficient extracting means sequentially extracts a predetermined number of coefficient sets at a time in a scan line direction of the two-dimensional signal.

3. An encoding device according to claim 1, characterized in that said coefficient extracting means sequentially extracts coefficient sets one by one.

4. An encoding device characterized by comprising:

element extracting means for sequentially extracting $2m \times 2$ (m is an integer: $m \geq 1$) spatially adjacent elements from a two-dimensional signal;

wavelet transforming means for dividing the $2m \times 2$ elements into a plurality of subband coefficient sets;

coefficient encoding means for encoding the coefficient sets; and

code output means for rearranging the encoded coefficient sets in order from a low-resolution subband, and outputting the rearranged coefficient

sets.

5. An encoding device according to claim 1, characterized in that

each coefficient comprises a plurality of components, and

said coefficient encoding means encodes each component of a coefficient, and generates a code by concatenating a code of each component below each coefficient.

6. An encoding device according to claim 4, characterized in that

each coefficient comprises a plurality of components, and

said coefficient encoding means encodes each component of a coefficient, and generates a code by concatenating a code of each component below each coefficient.

7. An encoding device according to claim 1, characterized in that

each coefficient comprises a plurality of components, and

said coefficient encoding means encodes each component of a coefficient, and generates a code by concatenating a code of each coefficient below each component.

8. An encoding device according to claim 4, characterized in that

each coefficient comprises a plurality of components, and

said coefficient encoding means encodes each component of a coefficient, and generates a code by concatenating a code of each coefficient below each component.

9. An encoding device according to claim 1, characterized by further comprising coefficient thinning map generating means

for generating a coefficient thinning map in which resolution at each spatial coordinate of the two-dimensional signal is set,

wherein said coefficient extracting means refers to the coefficient thinning map, and extracts coefficients by thinning the coefficients to the resolution set for the coordinate.

10. An encoding device according to claim 4, characterized by further comprising coefficient thinning map generating means for generating a coefficient thinning map in which resolution at each spatial coordinate of the two-dimensional signal is set,

wherein said coefficient extracting means refers to the coefficient thinning map, and extracts coefficients by thinning the coefficients to the resolution set for the coordinate.

11. An encoding device according to claim 9, characterized in that in the coefficient thinning map, resolution of a photograph region of the two-dimensional signal differs from resolution of a region other than a photograph.

12. An encoding device according to claim 10, characterized in that in the coefficient thinning map, resolution of a photograph region of the two-dimensional signal differs from resolution of a region other than a photograph.

13. An encoding device according to claim 11, characterized in that in the coefficient thinning map, the resolution of the photograph region of the two-dimensional signal is set lower than the resolution of the region other than a photograph.

14. An encoding device according to claim 12, characterized in that in the coefficient thinning map, the resolution of the photograph region of the two-dimensional signal is set lower than the resolution

of the region other than a photograph.

15. An encoding device according to claim 9, characterized in that in the coefficient thinning map, resolution of a region in which a displacement of an adjacent element value is relatively large differs from resolution of a region in which the displacement is relatively small in the two-dimensional signal.

16. An encoding device according to claim 10, characterized in that in the coefficient thinning map, resolution of a region in which a displacement of an adjacent element value is relatively large differs from resolution of a region in which the displacement is relatively small in the two-dimensional signal.

17. An encoding device according to claim 16, characterized in that in the coefficient thinning map, the resolution of the region in which the displacement of the adjacent element value is relatively large is set lower than the resolution of the region in which the displacement is relatively small in the two-dimensional signal.

18. An encoding device according to claim 9, characterized by further comprising updated region detecting means for detecting a updated region from a plurality of sequential frames of a sequence of a

plurality of frames forming the two-dimensional signal,

wherein said coefficient thinning map generating means generates a coefficient thinning map in which resolution of the updated region differs from resolution of a region other than the updated region.

19. An encoding device according to claim 10, characterized by further comprising updated region detecting means for detecting a updated region from a plurality of sequential frames of a sequence of a plurality of frames forming the two-dimensional signal,

wherein said coefficient thinning map generating means generates a coefficient thinning map in which resolution of the updated region differs from resolution of a region other than the updated region.

20. An encoding device according to claim 18, characterized in that

said updated region detecting means detects, as a updated region, a region in which a signal value is updated in said plurality of sequential frames, and

said coefficient thinning map generating means sets resolution of the detected updated region lower than resolution of a region other than the updated region.

21. An encoding device according to claim 19, characterized in that

said updated region detecting means detects, as a updated region, a region in which a signal value is updated in said plurality of sequential frames, and

said coefficient thinning map generating means sets resolution of the detected updated region lower than resolution of a region other than the updated region.

22. An encoding device according to claim 18, characterized in that

said updated region detecting means obtains a period during which a signal value changes in each partial region from said plurality of sequential frames, and

said coefficient thinning map generating means sets resolution of the coefficient thinning map on the basis of the changing period.

23. An encoding device according to claim 18, characterized in that

said updated region detecting means obtains a period during which a signal value changes in each partial region from said plurality of sequential frames, and

said coefficient thinning map generating means sets resolution of the coefficient thinning map on the basis of the changing period.

24. An encoding device according to claim 22, characterized in that said coefficient thinning map generating means sets low resolution in a region in which the changing period is long.

25. An encoding device according to claim 23, characterized in that said coefficient thinning map generating means sets low resolution in a region in which the changing period is long.

26. An encoding device according to claim 1, characterized by further comprising:

coefficient quantization map generating means for generating a coefficient quantization map indicating quantization accuracy at each spatial coordinate of the two-dimensional signal; and

coefficient quantizing means for quantizing a coefficient to quantization accuracy corresponding to a spatial coordinate of the coefficient by

referring to the coefficient quantization map,

wherein said coefficient encoding means encodes a set of the quantized coefficients.

27. An encoding device according to claim 4, characterized by further comprising:

coefficient quantization map generating means for generating a coefficient quantization map indicating quantization accuracy at each spatial coordinate of the two-dimensional signal; and

coefficient quantizing means for quantizing a coefficient to quantization accuracy corresponding to a spatial coordinate of the coefficient by referring to the coefficient quantization map,

wherein said coefficient encoding means encodes a set of the quantized coefficients.

28. An encoding device according to claim 26, characterized in that in the coefficient quantization map, quantization accuracy of a photograph region of the two-dimensional signal differs from quantization accuracy of a region other than a photograph.

29. An encoding device according to claim 27, characterized in that in the coefficient quantization map, quantization accuracy of a photograph region of the two-dimensional signal differs from quantization accuracy of a region other than a photograph.

30. An encoding device according to claim 28, characterized in that in the coefficient quantization map, the quantization accuracy of the photograph region is set lower than the quantization accuracy of the region other than a photograph.

31. An encoding device according to claim 29, characterized in that in the coefficient quantization map, the quantization

accuracy of the photograph region is set lower than the quantization accuracy of the region other than a photograph.

32. An encoding device according to claim 27, characterized in that in the coefficient quantization map, quantization accuracy of a first region, in which a displacement of an adjacent element value is larger than a threshold value, of the two-dimensional signal differs from quantization accuracy of a second region in which the displacement is smaller than the threshold value.

33. An encoding device according to claim 32, characterized in that in the coefficient quantization map, the quantization accuracy of the second region is set lower than the quantization accuracy of the first region.

34. An encoding device according to claim 26, characterized by further comprising updated region detecting means for detecting a updated region from a plurality of sequential frames of a sequence of a plurality of frames forming the two-dimensional signal,

wherein said coefficient quantization map generating means generates a coefficient quantization map in which quantization accuracy of the updated region differs from quantization accuracy of a region other than the updated region.

35. An encoding device according to claim 27, characterized by further comprising updated region detecting means for detecting a updated region from a plurality of sequential frames of a sequence of a plurality of frames forming the two-dimensional signal,

wherein said coefficient quantization map generating means generates a coefficient quantization map in which quantization accuracy of the updated region differs from quantization accuracy of a region other than the

updated region.

36. An encoding device according to claim 34, characterized in that

said updated region detecting means detects, as a updated region, a region in which a signal value is updated in said plurality of sequential frames, and

said coefficient thinning map generating means sets quantization accuracy of the detected updated region lower than quantization accuracy of a region other than the updated region.

37. An encoding device according to claim 35, characterized in that

said updated region detecting means detects, as a updated region, a region in which a signal value is updated in said plurality of sequential frames, and

said coefficient thinning map generating means sets quantization accuracy of the detected updated region lower than quantization accuracy of a region other than the updated region.

38. An encoding device according to claim 34, characterized in that

said updated region detecting means obtains a period during which a signal value changes in each partial region from said plurality of sequential frames, and

said coefficient quantization map generating means sets quantization accuracy of the coefficient quantization map on the basis of the changing period.

39. An encoding device according to claim 35, characterized in that

said updated region detecting means obtains a period during which a signal value changes in each partial region from said plurality of sequential frames, and

said coefficient quantization map generating means sets quantization accuracy of the coefficient quantization map on the basis of the changing period.

40. An encoding device according to claim 38, characterized in that said coefficient thinning map generating means sets low quantization accuracy in a region in which the changing period is long.

41. An encoding device according to claim 39, characterized in that said coefficient thinning map generating means sets low quantization accuracy in a region in which the changing period is long.

42. An encoding device according to claim 18, characterized in that said updated region detecting means detects a updated region by calculating a difference between said plurality of sequential frames.

43. An encoding device according to claim 19, characterized in that said updated region detecting means detects a updated region by calculating a difference between said plurality of sequential frames.

44. An encoding device according to claim 34, characterized in that said updated region detecting means detects a updated region by calculating a difference between said plurality of sequential frames.

45. An encoding device according to claim 35, characterized in that said updated region detecting means detects a updated region by calculating a difference between said plurality of sequential frames.

46. An encoding device according to claim 18, characterized in that said updated region detecting means detects, as a updated region, an overlapping region of a region to be encoded of a preceding frame

and a region to be encoded of a succeeding frame.

47. An encoding device according to claim 19, characterized in that said updated region detecting means detects, as a updated region, an overlapping region of a region to be encoded of a preceding frame and a region to be encoded of a succeeding frame.

48. An encoding device according to claim 34, characterized in that said updated region detecting means detects, as a updated region, an overlapping region of a region to be encoded of a preceding frame and a region to be encoded of a succeeding frame.

49. An encoding device according to claim 35, characterized in that said updated region detecting means detects, as a updated region, an overlapping region of a region to be encoded of a preceding frame and a region to be encoded of a succeeding frame.

50. A decoding device characterized by comprising:

initial coefficient decoding means for receiving a code sequence formed by encoding coefficients of a plurality of subbands obtained by wavelet transform, and decoding a coefficient of a lowest-frequency subband from a code sequence corresponding to the lowest-frequency subband;

coefficient decoding means for decoding sets of coefficients for every predetermined number of sets of coefficients which belong to the same spatial position in a plurality of subbands which belong to a wavelet transform level of the same hierarchy from a code sequence following the lowest-frequency subband code sequence; and

inverse wavelet transforming means for performing inverse wavelet transform whenever the coefficient set is decoded, thereby generating the original two-dimensional signal.

51. A decoding device according to claim 50, characterized in that said coefficient decoding means sequentially decodes a predetermined number of coefficient sets at a time in a scan line direction of the two-dimensional signal.

52. A decoding device according to claim 51, characterized in that said coefficient decoding means sequentially decodes the coefficient sets one by one.

53. A decoding device according to claim 52, characterized in that

each coefficient comprises a plurality of components, and

said coefficient decoding means decodes each component of a coefficient, and concatenates each component below each coefficient.

54. A decoding device according to claim 52, characterized in that

each coefficient comprises a plurality of components, and

said coefficient decoding means decodes each component of a coefficient.

55. An encoding method characterized by comprising the steps of:

dividing a two-dimensional signal into subbands as a plurality of frequency regions by wavelet transform;

extracting sets of coefficients for every predetermined number of sets of coefficients which belong to the same spatial position from a plurality of subbands which belong to a wavelet decomposition level of the same hierarchy; and

encoding the extracted coefficient sets.

56. An encoding method according to claim 55,

characterized in that in the extracting step, a predetermined number of coefficient sets are sequentially extracted at a time in a scan line direction of the two-dimensional signal.

57. An encoding method according to claim 55, characterized in that in the extracting step, coefficient sets are sequentially extracted one by one.

58. An encoding method characterized by comprising the steps of:

sequentially extracting $2m \times 2$ (m is an integer: $m \geq 1$) spatially adjacent elements from a two-dimensional signal;

dividing the $2m \times 2$ elements into a plurality of subband coefficient sets by wavelet transform;

encoding the coefficient sets; and

rearranging the encoded coefficient sets in order from a low-resolution subband, and outputting the rearranged coefficient sets.

59. An encoding method according to claim 55, characterized by further comprising the step of generating a coefficient thinning map in which resolution at each spatial coordinate of the two-dimensional signal is set,

wherein in the extracting step, the coefficients which belong to the same spatial position are extracted after being thinned to the resolution set for the coordinate by referring to the coefficient thinning map.

60. An encoding method according to claim 58, characterized by further comprising the step of generating a coefficient thinning map in which resolution at each spatial coordinate of the two-dimensional signal is set,

wherein in the extracting step, the coefficients of the $2m \times 2$

elements are extracted after being thinned to the resolution set for the coordinate by referring to the coefficient thinning map.

61. An encoding method according to claim 59, characterized by further comprising the step of detecting a updated region from a plurality of sequential frames of a sequence of a plurality of frames forming the two-dimensional signal,

wherein in the step of generating the coefficient thinning map, a coefficient thinning map in which resolution of the updated region differs from resolution of a region other than the updated region is generated.

62. An encoding method according to claim 60, characterized by further comprising the step of detecting a updated region from a plurality of sequential frames of a sequence of a plurality of frames forming the two-dimensional signal,

wherein in the step of generating the coefficient thinning map, a coefficient thinning map in which resolution of the updated region differs from resolution of a region other than the updated region is generated.

63. An encoding method according to claim 55, characterized by further comprising the steps of:

generating a coefficient quantization map indicating quantization accuracy at each spatial coordinate of the two-dimensional signal; and

quantizing coefficients which belong to the same spatial position to quantization accuracy corresponding to spatial coordinates of the coefficients by referring to the coefficient quantization map,

wherein in the encoding step, a set of the quantized coefficients are encoded.

64. An encoding method according to claim 58, characterized by further comprising the steps of:

generating a coefficient quantization map in which quantization accuracy at each spatial coordinate of the two-dimensional signal is set; and

quantizing coefficients of the 2m × 2 elements to quantization accuracy corresponding to spatial coordinates of the coefficients by referring to the coefficient quantization map,

wherein in the encoding step, a set of the quantized coefficients are encoded.

65. An encoding method according to claim 63, characterized by further comprising the step of detecting a updated region from a plurality of sequential frames of a sequence of a plurality of frames forming the two-dimensional signal,

wherein in the step of generating the coefficient quantization map, a coefficient quantization map in which quantization accuracy of the updated region differs from quantization accuracy of a region other than the updated region is generated.

66. An encoding method according to claim 64, characterized by further comprising the step of detecting a updated region from a plurality of sequential frames of a sequence of a plurality of frames forming the two-dimensional signal,

wherein in the step of generating the coefficient quantization map, a coefficient quantization map in which quantization accuracy of the updated region differs from quantization accuracy of a region other than the updated region is generated.

67. An encoding method according to claim 65, characterized in that the step of generating the coefficient quantization map is executed before the step of encoding a subband coefficient set.

68. An encoding method according to claim 66,

characterized in that the step of generating the coefficient quantization map is executed before the step of encoding a subband coefficient set.

69. An encoding method according to claim 67, characterized in that the step of generating the coefficient quantization map is executed before all steps of encoding a subband coefficient set.

70. An encoding method according to claim 68, characterized in that the step of generating the coefficient quantization map is executed before all steps of encoding a subband coefficient set.

71. A decoding method characterized by comprising the steps of:

receiving a code sequence formed by encoding coefficients of a plurality of subbands obtained by wavelet transform;

decoding a coefficient of a lowest-frequency subband from a code sequence corresponding to the lowest-frequency subband;

decoding sets of coefficients for every predetermined number of sets of coefficients which belong to the same spatial position in a plurality of subbands which belong to a wavelet transform level of the same hierarchy from a code sequence following the lowest-frequency subband code sequence; and

performing inverse wavelet transform whenever the coefficient set is decoded, thereby generating the original two-dimensional signal.

72. A decoding method according to claim 71, characterized in that in the decoding step, a predetermined number of coefficient sets are sequentially decoded at a time in a scan line direction of the two-dimensional signal.

73. A decoding method according to claim 72, characterized in that in the decoding step, the coefficient sets are sequentially decoded one by one.

74. An encoding program characterized by causing a computer to execute the steps of:

dividing a two-dimensional signal into subbands as a plurality of frequency regions by wavelet transform;

extracting sets of coefficients for every predetermined number of sets of coefficients which belong to the same spatial position from a plurality of subbands which belong to a wavelet decomposition level of the same hierarchy; and

encoding the extracted coefficient sets.

75. An encoding program characterized by causing a computer to execute the steps of:

sequentially extracting $2m \times 2$ (m is an integer: $m \geq 1$) spatially adjacent elements from a two-dimensional signal;

dividing the $2m \times 2$ elements into a plurality of subband coefficient sets by wavelet transform;

encoding the coefficient sets; and

rearranging the encoded coefficient sets in order from a low-resolution subband, and outputting the rearranged coefficient sets.

76. An encoding program according to claim 74, characterized by causing the computer to execute the steps of:

generating a coefficient thinning map in which resolution at each spatial coordinate of the two-dimensional signal is set; and

extracting the coefficients which belong to the same spatial position by thinning the coefficients to the resolution set for the coordinate by referring to the coefficient thinning map.

77. An encoding program according to claim 75, characterized by causing the computer to execute the steps of:

generating a coefficient thinning map in which resolution at each spatial coordinate of the two-dimensional signal is set; and

extracting coefficients of the 2m × 2 elements by thinning the coefficients to the resolution set for the coordinate by referring to the coefficient thinning map.

78. An encoding program according to claim 76, characterized by causing the computer to execute the steps of:

detecting a updated region from a plurality of sequential frames of a sequence of a plurality of frames forming the two-dimensional signal; and

generating a coefficient thinning map in which resolution of the updated region differs from resolution of a region other than the updated region.

79. An encoding program according to claim 77, characterized by causing the computer to execute the steps of:

detecting a updated region from a plurality of sequential frames of a sequence of a plurality of frames forming the two-dimensional signal; and

generating a coefficient thinning map in which resolution of the updated region differs from resolution of a region other than the updated region.

80. An encoding program according to claim 74, characterized by causing the computer to execute the steps of:

generating a coefficient quantization map in which quantization accuracy of a coefficient at each spatial coordinate of the two-dimensional signal is set; and

quantizing the coefficients which belong to the same spatial position to the quantization accuracy set for the coordinate by referring to the coefficient quantization map, and encoding the quantized coefficients.

81. An encoding program according to claim 75, characterized by causing the computer to execute the steps of:

generating a coefficient quantization map in which quantization accuracy of a coefficient at each spatial coordinate of the two-dimensional signal is set; and

quantizing the coefficients which belong to the same spatial position to the quantization accuracy set for the coordinate by referring to the coefficient quantization map, and encoding the quantized coefficients.

82. An encoding program according to claim 80, characterized by causing the computer to execute the steps of:

detecting a updated region from a plurality of sequential frames of a sequence of a plurality of frames forming the two-dimensional signal; and

generating a coefficient quantization map in which quantization accuracy of the updated region differs from quantization accuracy of a region other than the updated region.

83. An encoding program according to claim 81, characterized by causing the computer to execute the steps of:

detecting a updated region from a plurality of sequential frames of a sequence of a plurality of frames forming the two-dimensional signal; and

generating a coefficient quantization map in which quantization accuracy of the updated region differs from quantization accuracy of a region other than the updated region.

84. A decoding program characterized by causing a computer to execute the steps of:

receiving a code sequence formed by encoding coefficients of a plurality of subbands obtained by wavelet transform;

decoding a coefficient of a lowest-frequency subband from a code sequence corresponding to the lowest-frequency subband;

decoding sets of coefficients for every predetermined number of

sets of coefficients which belong to the same spatial position in a plurality of subbands which belong to a wavelet transform level of the same hierarchy from a code sequence following the lowest-frequency subband code sequence; and

performing inverse wavelet transform whenever the coefficient set is decoded, thereby generating the original two-dimensional signal.

85. A communication terminal characterized by comprising:

image input means;

communicating means for transmitting and receiving an encoded image signal;

wavelet transforming means for dividing an image signal to be transmitted, which is input by said image input means, into subbands as a plurality of frequency regions;

coefficient extracting means for extracting sets of coefficients for every predetermined number of sets of coefficients which belong to the same spatial position from a plurality of subbands which belong to a wavelet decomposition level of the same hierarchy;

coefficient encoding means for encoding the extracted coefficient sets, and outputting the encoded coefficient sets to said communicating means;

initial coefficient decoding means for decoding a coefficient of a lowest-frequency subband of a received image signal from a code sequence corresponding to the lowest-frequency subband;

coefficient decoding means for decoding sets of coefficients for every predetermined number of sets of coefficients which belong to the same spatial position in a plurality of subbands which belong to a wavelet transform level of the same hierarchy from a code sequence following the lowest-frequency subband code sequence;

inverse wavelet transforming means for performing inverse wavelet transform whenever the coefficient set is decoded, thereby generating the received image signal; and

image display means for displaying a received image on the basis of the received image signal.